PCB Data Overview

for the
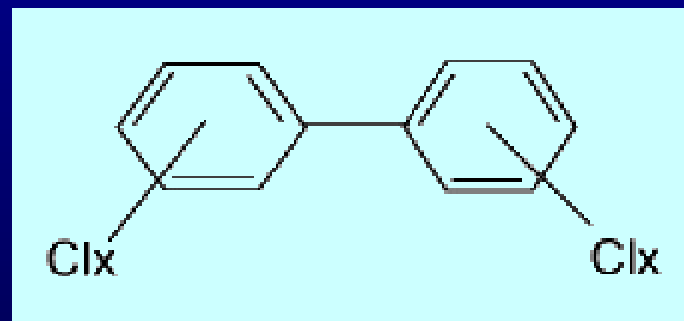
Development of the Roanoke River TMDL
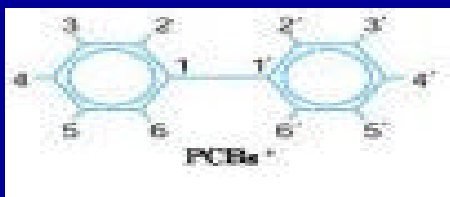
Mark Richards

July 16, 2007

Technical Advisory Committee

Discussion Overview

- PCB 101

- WQS vs Site Specific PCB Endpoint

- Study Design & Analytical Approach

- Technical Issue & Applied Solution

- PCB Data Results
  - Grab Samples
  - SPMDs
  - Effluent Samples

- Where do we go from here?

PCBs

- Biphenyl molecule with a specific number of chlorine atoms

- 209 distinct PCB Compounds (Congeners)

- Total PCB = Summation of 209 Congeners
  - Basis for WQS

- Homologs (1-10 chlorine atoms; 10 groups)

- Aroclors – mixture of congeners
 - Aroclor 1254 is 54% chlorine

PCB Criterion

- Water Quality Standard (tPCB) = 0.0017 ug/L (ppb) = 1.7 ng/L (ppt) = <u>1,700 pg/L</u> (ppq)

- Equivalent Fish Conc. = 50 ng/g
  - Conc. in water column where accumulation of PCBs in fish should be at a level protective of fish tissue for consumption (humans)

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Site Specific PCB Endpoint

- Existing WQS (1,700 pg/L) is not likely protective of fish tissue

- Proposed WQS 640 pg/L (fish tissue threshold of 20 ng/g)

- Potomac R. water/sediment endpoints
  - 64 pg/L (derived using BAF) → 50 ng/g
  - 7.18 ng/g sediment (derived using BSAF)

- Applicable to the Roanoke River
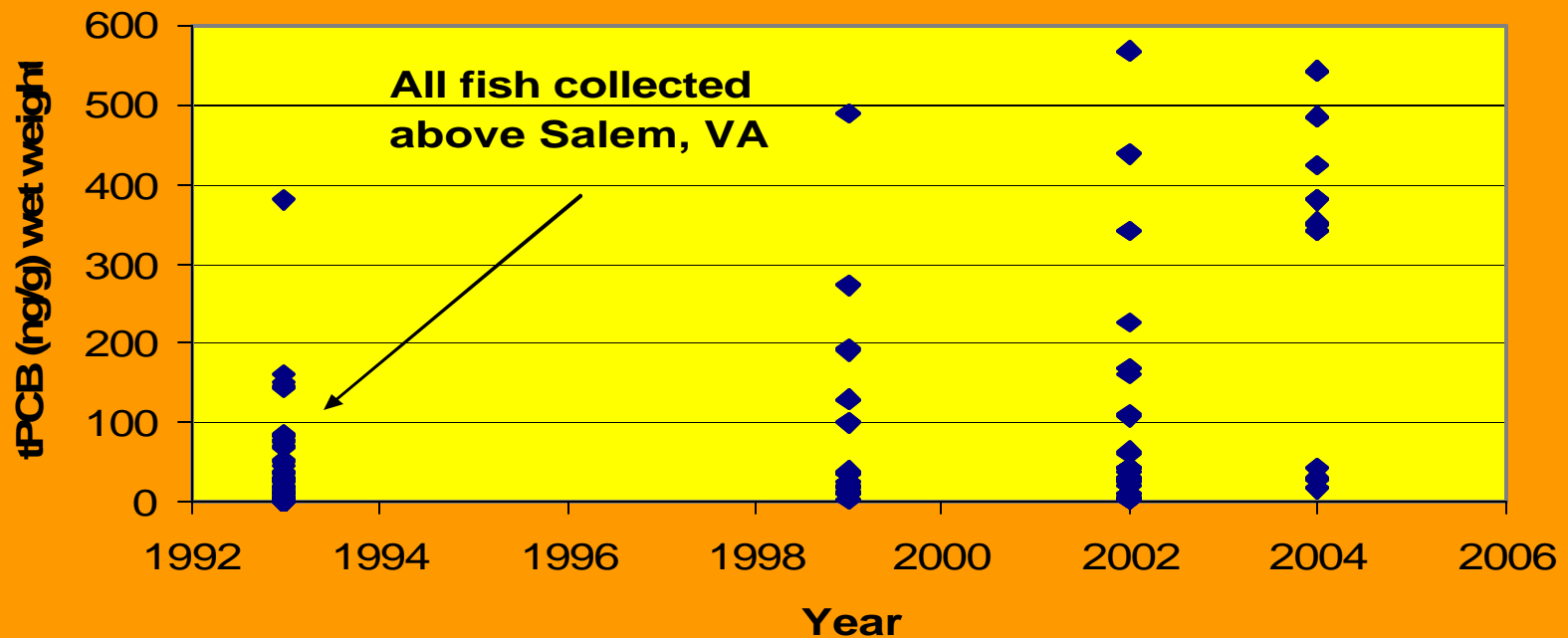
Roanoke River Watershed Fish Consumption Advisories
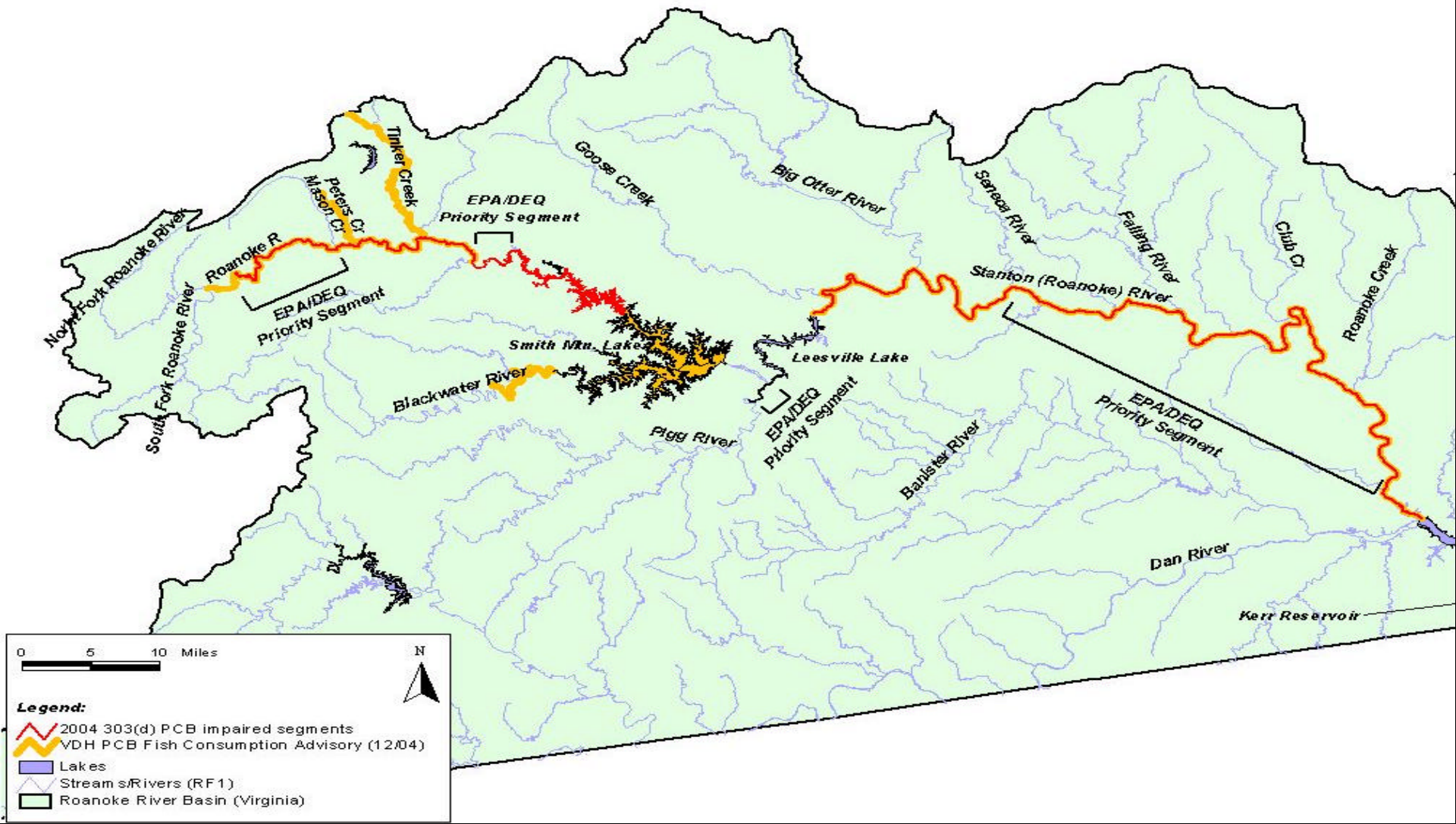
tPCB in Fish Tissue

tPCB in all fish spp. from the Roanoke/Staunton R. (RM 220 - RM 4) from 1993 - 2006
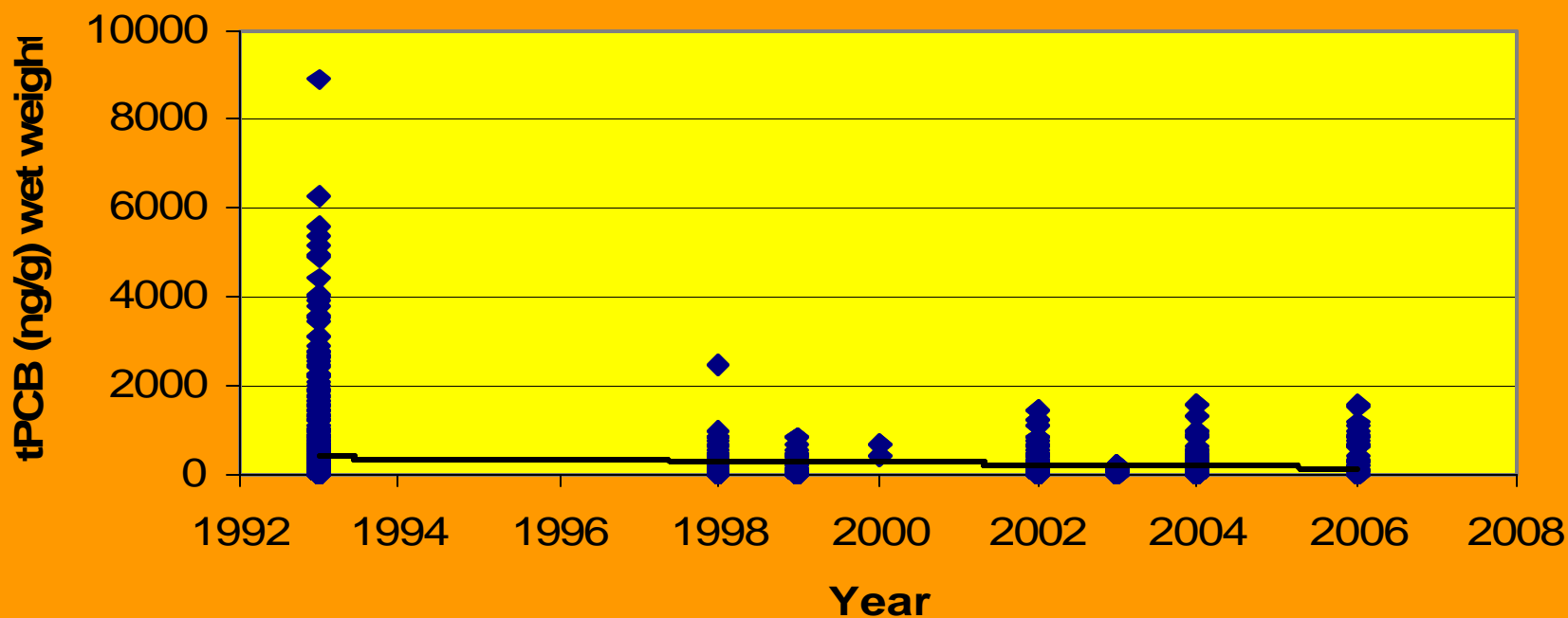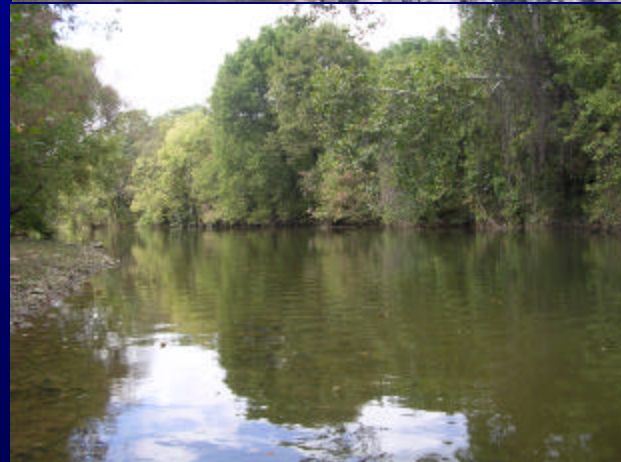
tPCB in Fish – Upper Roanoke R.

tPCB in all fish from the Upper Roanoke R. (RM 220 - RM 199.6) from 1993 - 2004

All fish collected above Salem, VA

tPCB (ng/g) wet weight

Year

TMDL Study

- Study Design
  - Ambient (Water Column) Grab Samples
  - Semi-Permeable Membrane Devices (SPMDs)
  - Point Source Effluent Samples

Ambient Grab Samples

- No historic water data
- Taken at 5 sites
  - Low & High flow condition
  - USGS gages
- Account for "events"
- Analysis with low detect PCB method

USGS 02055000 ROANOKE RIVER AT ROANOKE, VA

---------- EXPLANATION ----------
DISCHARGE
MEDIAN DAILY STREAMFLOW BASED ON 102 YEARS OF RECORD
MEASURED Discharge

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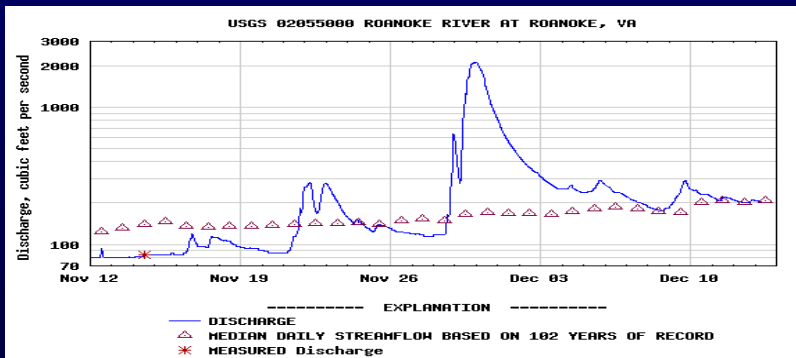
Semi-Permeable Membrane Devices (SPMDs)

"Virtual Fish"

Sequester PCBs over time ($\geq$30d)

Bracket potential sources

25 deployed: 21 retrieved

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Generate Effluent Data for Point Source Loadings

- **Need:** Develop PS PCB loadings

- **Goal:** Collect data*

  - Permittees historically analyzed for PCBs

    - Methods insenstive

  - adopt sampling and analytical procedures (EPA 1668A)

  - Guidance under development

  - --

  * *Not for permit compliance*

PCB Analytical Method

- EPA Method 1668, Revision A
  - High Resolution Gas Chromatography/ High Resolution Mass Spec
  - Analyzes 209 Congeners
- U.S. EPA Fort Meade Laboratory
  - Lowest Calibration Level (QL) for each congener(10 pg/L H_2O, SPMD 20 pg/SPMD)

PCB Results

tPCB Data Interpretation

- Consider all reported and est. values
- Congener conc. is est. value when < LCL
  - "J" Flagged values
  - Estimated congeners included in tPCB
- All non-detects set to "0"
- Conservative Approach

PCB Analytical Method

- Technical Difficulties:
  - Sample Concentration (20 µL)
    - Horizon DryVap
    - Automates concentrating process
      - Technology used for ug/L range, not for pg/L
  - Resulted in PCB contamination carry-over

Data Issue/Solution

- Applies to amb grabs, SPMD and Eff data

- MB contamination (congener specific)

- Significant portion of data flagged with a "B"

- Solution (EPA "Pumpkin Book", 1993)

I. Congener present in blank but not in sample – ok

II. Congener > 5X conc. in blank, probably present in sample at specified conc. (could use)

III. Congener $\geq$ 10X conc. in blank – ok

- Applied I & III; Only data meeting these conditions were summed for tPCB

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Ambient Results

	River Mile	Base Flow (pg/L)	High Flow (pg/L)
Lafayette, VA	ROA 227.42	57.37	Not Analyzed
Walnut Ave Bridge	ROA 204.76	0	876.2
Below Niagra Dam	ROA 199.2	53.4	465.5
Rt 746 Bridge	ROA 67.91	57.62	990.86
Rt 360 Bridge	ROA 59.12	262.43	1,316.9

Water Quality Criterion = 1,700 pg/L

Proposed (Triennial Review) 640 pg/L

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Ambient PCB Results

tPCB Concentrations from Grab Samples Collected at Base and High Flow Condition
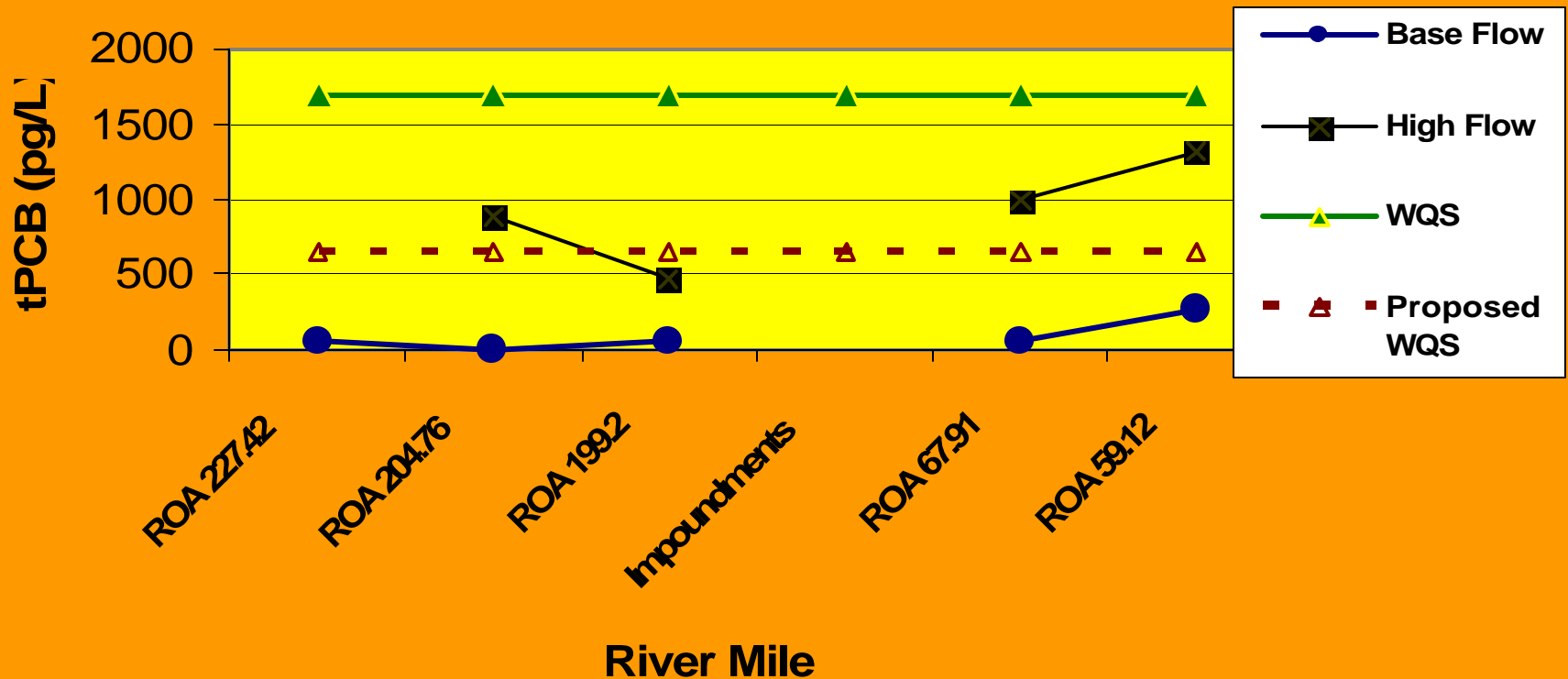
SPMDs

- Deployed 25 SPMDs
  - 12 Upper Roanoke
  - 13 Lower Roanoke
- Period of deployment ranged from 28-59d
  - Dry period followed deployment
- Retrieved & analyzed 21 SPMDs
- Analyzed using 1668A
- Several samples required 10-100x dilution
  - Results conservative

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SPMDs

- Received data from lab in pg/SPMD
- Converted each PCB congener to water column conc. using estimator model from USGS
- Co-eluting congeners adjusted for Aroclor conc.
  - May have introduced some bias (excludes weathering, etc.)
- Only accounts for dissolved fraction
- Some SPMDs were partially buried in sediment (e.g. XLN 000.00)
 - Can affect result

SPMD Results- Upper Roanoke

	River Mile	Tributary	Estimated tPCB (pg/L) SPMD
	ROA 219.99		598.8
Salem, VA	ROA 215.13		449.8
	←	MSN 000.67	2,591.2
Peters Crk - Below Indus outfall	←	PEE 000.00	1,281.4
City of Roanoke	ROA 207.08		1,795.1
	ROA 204.76		2,220.8 *
Below Roanoke Indus. Park	ROA 202.2		31,768.7 *
	←	TKR 000.69	1,602.8
Below STP	ROA 200.06		26,326.4 *

* Sample Diluted

SPMD Results- Upper Roanoke

Upper Roanoke River tPCB - estimated water concentration and daily ave. water concentration (WQS = 1,700 pg/L)
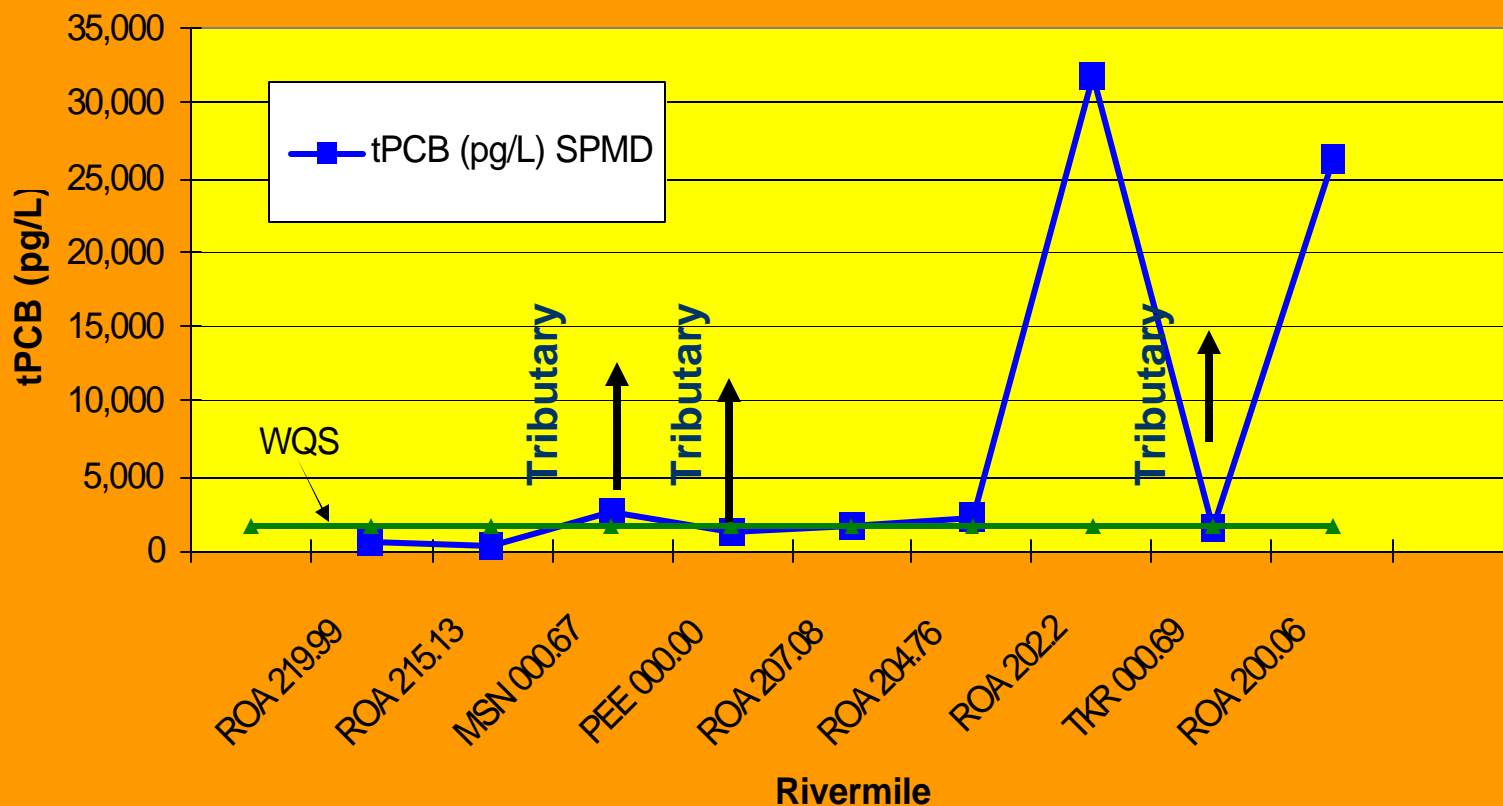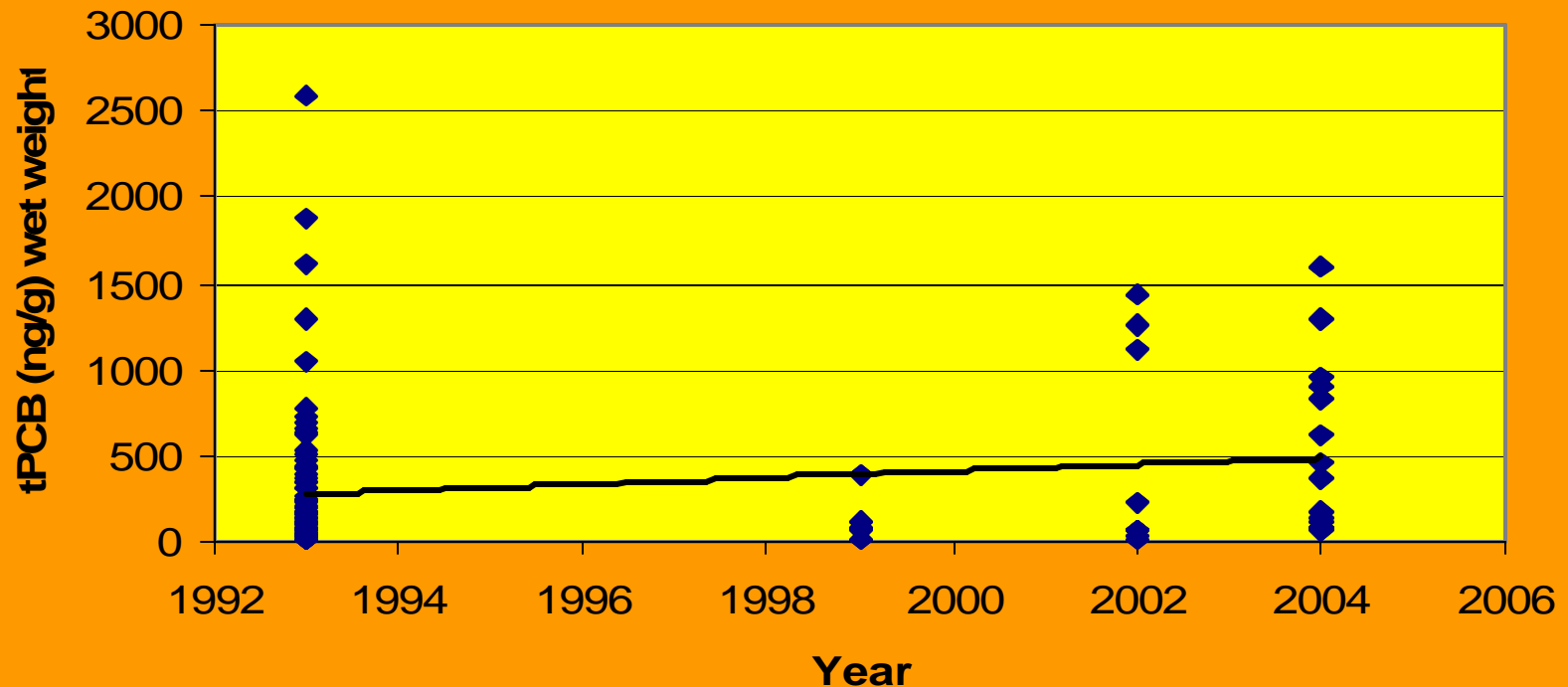
SPMD Results- Middle Roanoke

River Mile (Below Niagra Dam)		tPCB (pg/L)
Immediately Below Niagra Dam	ROA 199.2	710,495.1
	ROA 196.98	6,519.9

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tPCB in Fish – Middle Roanoke R.

tPCB in all fish from the Middle Roanoke R. (RM 199.2 - RM 193) from 1993 - 2004

SPMD Results- Lower Roanoke
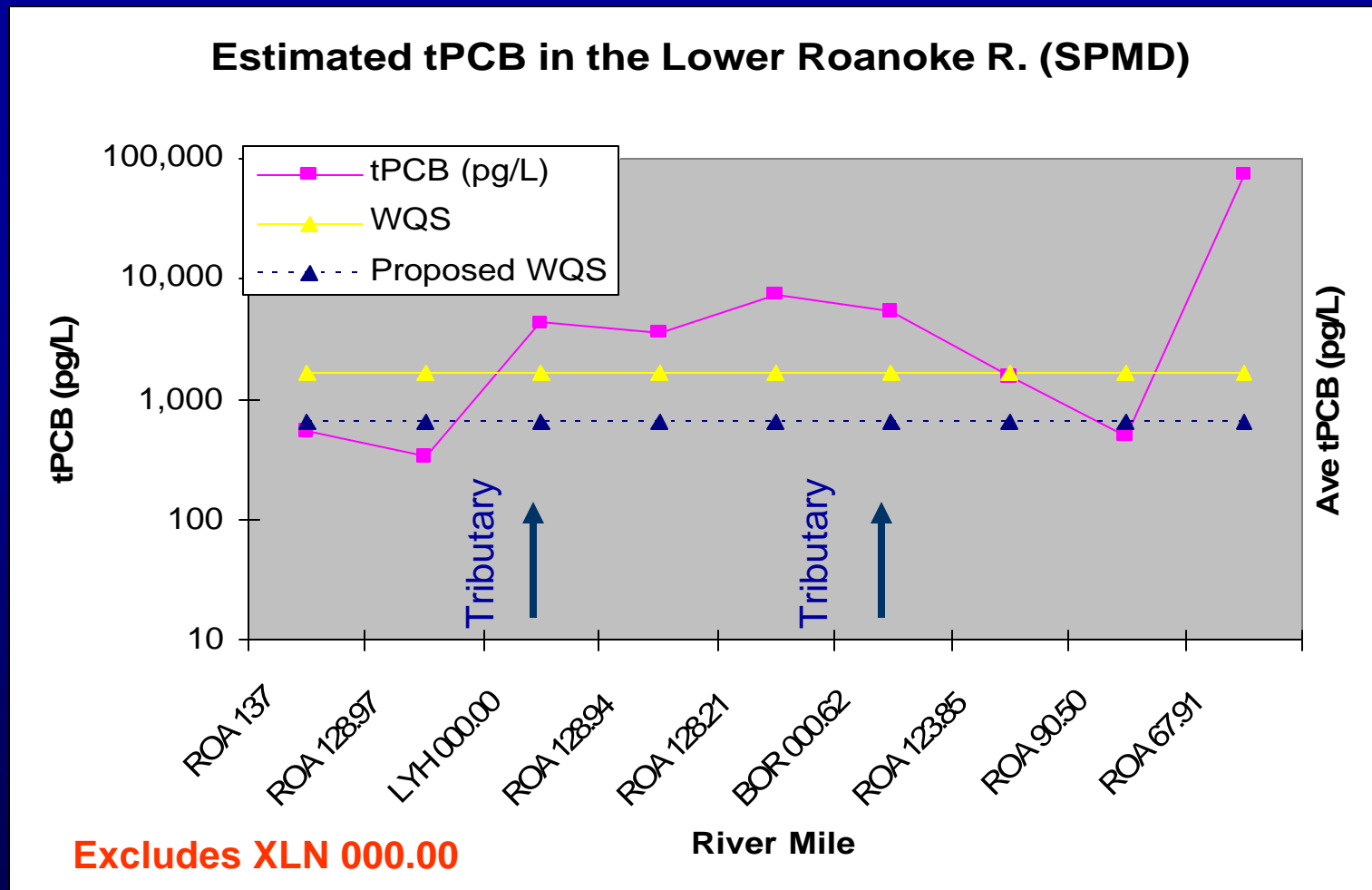
River Mile		Estimated tPCB (pg/L)
Below Leesville Dam	ROA 137.00	538.6
Upstream of Altavista	ROA 128.97	332.5
Lynch Creek	← LYH 000.00	4,214.6 *
Near old Lane West Landfill	ROA 128.94	3,672.2 *
Unnamed Tributary near BGF Industries	← XLN 000.00	15,642,675.0 *
Near old Lane East Landfill	ROA 128.21	7,221.9 *
Big Otter River Rte. 712	← BOR 000.62	5,338.5 *
Old Mansion Bridge Downstream of Altavista	ROA 123.85	1,558.2 *
Route 620 Downstream of Brookneal	ROA 90.50	496.7
Route 746 near Randolph	ROA 67.91	74,309.2 *

* Sample Diluted

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SPMD Results- Lower Roanoke

Estimated tPCB in the Lower Roanoke R. (SPMD)

Excludes XLN 000.00

Effluent Results

Facility	Concentration (pg/L)
Altavista STP	1,979
Dan River	504.3*
Western VA Sewage Authority	50.3
Burlington Hurt	60,372
Steel Dynamics	1,085

* < 2 liters (insufficient volume to adequately characterize)

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Additional Monitoring & Analysis

- Additional Monitoring
  - Collect water samples
  - Effluent samples
- TMDL Model being developed
- Additional Analysis
  - Statistical based approach for possible source ID
  - Homolog analysis with fish tissue and sediment

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